

Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

1-54. (Canceled)

55. (Previously Presented) A spray nozzle comprising:

a swirl disk formed of a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inch, an etched peripheral edge, an etched first region spaced inwardly relative to the etched peripheral edge and forming a first aperture extending through the first region and defining a swirl chamber, and an etched second region extending between the swirl chamber and peripheral edge and defining a second aperture extending through the second region forming a flow inlet to the swirl chamber;

an orifice disk formed of a sheet material substrate defining a thickness within the range of about 0.005 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge, and an etched first region spaced inwardly relative to the peripheral edge and defining a first aperture extending through the first region and forming a spray orifice;

a retaining body defining an inlet aperture and an outlet aperture; and

a retaining member receivable within the retaining body;

wherein at least one fluid passageway is formed between the inlet aperture of the retaining body and the flow inlet to the swirl chamber; the orifice disk is positioned within the retaining body with the spray orifice aligned with and adjacent to the outlet aperture of the retaining body; the swirl disk is positioned within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk; and the retaining member is positioned within the retaining body in engagement with an opposite side of the swirl disk relative to the orifice disk to secure the retaining member, the orifice disk and swirl disk within the retaining body.

56. (Previously Presented) A spray nozzle as defined in claim 55, wherein the swirl disk further defines a first substantially planar surface on one side of the swirl disk, and a second substantially planar surface on an opposite side of the swirl disk.

57. (Previously Presented) A spray nozzle as defined in claim 56, wherein the first and second surfaces are substantially symmetrical about a plane approximately perpendicular to an axis of the swirl disk.

58. (Previously Presented) A spray nozzle as defined in claim 57, wherein the first and second surfaces of the swirl disk are substantially identical.

59. (Currently Amended) A spray nozzle as defined in claim ~~56~~ 55, wherein at least one of the surfaces of the swirl disk includes a wear-resistant coating.

60. (Previously Presented) A spray nozzle as defined in claim ~~56~~ 55, wherein at least one of the surfaces of the orifice disk includes a wear-resistant coating.

61. (Previously Presented) A spray nozzle as defined in claim 55, wherein the swirl disk defines a throat formed between the swirl inlet and swirl chamber, the swirl chamber defines a start radius, and the ratio of the throat divided by the start radius is within the range of about 0.6 through about 1.1.

62. (Previously Presented) A spray nozzle as defined in claim 55, wherein the swirl disk defines a thickness within the range of about 0.005 inch through about 0.015 inch.

63. (Previously Presented) A spray nozzle as defined in claim 55, wherein the orifice disk defines a thickness within the range of about 0.015 inch through about 0.025 inch.

64. (Previously Presented) A spray nozzle as defined in claim 55, wherein the ratio of the axial depth of the spray orifice (L) to a diameter of the spray orifice (D) is within the range of about 0.16 through about 6.

65. (Currently Amended) A spray nozzle as defined in claim 55, wherein the retaining member defines at least one flat, and the flat defines a fluid flow path between the retaining member and retaining body and extending between the inlet of the retaining body and an annulus formed

between the ~~plug~~ retaining member and retaining body for fluid flow therebetween.

66. (Previously Presented) A spray nozzle as defined in claim 55, further comprising a filter adjacent to the retaining member for preventing contaminants from entering the spray nozzle.

67. (Previously Presented) A spray nozzle as defined in claim 55, wherein the swirl disk further defines a plurality of swirl chambers and a plurality of corresponding swirl inlets, and each swirl inlet extends between a respective swirl chamber and the peripheral edge of the swirl disk.

68. (Previously Presented) A swirl disk ~~defining a flow inlet and a swirl chamber~~ for use in a spray nozzle, wherein the spray nozzle includes a retaining body defining an inlet aperture and an outlet aperture, an orifice disk defining a peripheral edge and a spray orifice spaced inwardly relative to the peripheral edge and extending therethrough, and a retaining member, wherein the orifice disk is ~~received~~ receivable within the retaining body with the spray orifice aligned with and adjacent to the outlet aperture of the retaining body, ~~the swirl disk is received within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk, at least one fluid passageway is formed between the inlet aperture of the retaining body and the flow inlet to the swirl chamber, and the retaining member is received within the retaining body in engagement with an opposite side of the swirl disk relative to the orifice disk, and secures the orifice disk and swirl disk within the retaining body, wherein the swirl disk comprises~~ comprising:

a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 ~~inches~~ inch, an etched peripheral portion defining a peripheral edge of the swirl disk, an etched first region spaced inwardly relative to the peripheral edge and forming a first aperture extending through the first region and defining a swirl chamber of the swirl disk, and an etched second region of the sheet material substrate extending between the swirl chamber and peripheral edge and defining a second aperture extending through the second region and forming a flow inlet to the swirl chamber of the swirl disk, wherein the swirl disk is receivable within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk and at least one fluid passageway formed between the inlet aperture of the retaining body and the flow inlet to the

swirl chamber, and an opposite side of the swirl disk relative to the orifice disk is engageable with the retaining member to secure the swirl disk and orifice disk within the retaining body.

69. (Currently Amended) A swirl disk ~~as defined in claim 68,~~ in combination with an orifice disk for use in a spray nozzle, wherein the spray nozzle includes a retaining body defining an inlet aperture and an outlet aperture, and a retaining member, the combination comprising:

an orifice disk formed of a sheet material substrate defining a thickness within the range of about 0.005 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge of the orifice disk, and an etched first region of the sheet material substrate spaced inwardly relative to the peripheral edge and defining a first aperture extending through the first region and forming a spray orifice of the orifice disk, wherein the orifice disk is receivable within the retaining body with the spray orifice aligned with and adjacent to the outlet aperture of the retaining body; and

a swirl disk formed of a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge of the swirl disk, an etched first region spaced inwardly relative to the peripheral edge and forming a first aperture extending through the first region and defining a swirl chamber, and an etched second region of the sheet material substrate extending between the swirl chamber and the peripheral edge and defining a second aperture extending through the second region and forming a flow inlet to the swirl chamber, wherein the swirl disk is receivable within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk and at least one fluid passageway formed between the inlet aperture of the retaining body and the flow inlet to the swirl chamber, and an opposite side of the swirl disk relative to the orifice disk is retainable by the retaining member to secure the swirl disk and orifice disk within the retaining body.

70. (Currently Amended) A swirl disk ~~as defined in claim 68, wherein the swirl disk further defines~~ for use in a spray nozzle, wherein the spray nozzle includes a retaining body defining an inlet aperture and an outlet aperture, an orifice disk defining a peripheral edge and a spray orifice spaced inwardly relative to the peripheral edge and extending therethrough, and a retaining member, wherein the orifice disk is receivable within the retaining body with the spray orifice aligned with and adjacent to the outlet aperture of the retaining body, the swirl disk comprising:

a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge of the swirl disk, an etched first region spaced inwardly relative to the peripheral edge and forming a first aperture extending through the first region and defining a swirl chamber of the swirl disk, and an etched second region of the sheet material substrate extending between the swirl chamber and peripheral edge and defining a second aperture extending through the second region and forming a flow inlet to the swirl chamber of the swirl disk, wherein the swirl disk further defines a throat between an upstream end of the swirl flow inlet and the swirl chamber, a start radius within the swirl chamber, and a throat ratio defined by the ratio of the throat to the start radius and within the range of about 3:5 to about 11:10, wherein the swirl disk is receivable within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk and at least one fluid passageway formed between the inlet aperture of the retaining body and the flow inlet to the swirl chamber, and an opposite side of the swirl disk relative to the orifice disk is retainable by the retaining member to secure the swirl disk and orifice disk within the retaining body.

71. (Previously Presented) A swirl disk as defined in claim 68, wherein the swirl disk further defines a first substantially planar surface on one side of the swirl disk, and a second substantially planar surface on an opposite side of the swirl disk.

72. (Previously Presented) A swirl disk as defined in claim 71, wherein the first and second surfaces are substantially symmetrical about a plane approximately perpendicular to an axis of the swirl disk.

73. (Previously Presented) A swirl disk as defined in claim 72, wherein the first and second surfaces of the swirl disk are substantially identical.

74. (Previously Presented) A spray nozzle comprising:

means for generating a swirling flow of fluid formed of a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inch, an etched peripheral edge, an etched first region spaced inwardly relative to the peripheral edge and forming a first

aperture extending through the first region and defining means for swirling fluid within the means for generating, and an etched second region extending between the means for swirling and the peripheral edge and defining a second aperture extending through the second region and forming means for introducing a flow of fluid into the means for swirling;

means for emitting a spray of fluid exiting the means for generating and formed of a sheet material substrate defining a thickness within the range of about 0.005 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge, and an etched first region spaced inwardly relative to the peripheral edge and defining a first aperture extending through the first region and forming a spray orifice in fluid communication with the means for swirling for receiving the swirling fluid and emitting a spray of such fluid therethrough;

means for retaining the means for generating and means for emitting and defining an inlet aperture in fluid communication with the means for generating for introducing fluid into the means for generating and an outlet aperture in fluid communication with the means for emitting for emitting the spray of fluid therethrough; and

means receivable within the means for retaining for securing the means for generating and means for emitting within the means for retaining.

75. (Previously Presented) A spray nozzle as defined in claim 74, wherein the means for emitting is received within the means for retaining with the spray orifice aligned with and adjacent to the outlet aperture of the means for retaining, the means for generating is received within the means for retaining upstream of and contiguous to the means for emitting with the means for swirling aligned and in fluid communication with the spray orifice of the means for emitting, and the means for securing is in engagement with an opposite side of the means for generating relative to the means for emitting.

76. (Previously Presented) A spray nozzle as defined in claim 74, wherein the means for emitting emits the fluid from the spray orifice in a spray of droplets, and at least about 90% of the emitted spray is composed of droplets having diameters of less than about 62.8 microns at a fluid pressure in the range of about 1000 psi to about 3000 psi.

77. (Previously Presented) A spray nozzle as defined in claim 76, wherein the spray of droplets defines a Sauter Mean Diameter on the order of about 20 microns.

78. (Previously Presented) A spray nozzle as defined in claim 75, wherein the means for generating is a swirl disk, the means for swirling is a swirl chamber of the swirl disk, the means for introducing is an inlet to the swirl chamber, the means for emitting is an orifice plate, the means for retaining is a nozzle body, and the means for securing is a retaining plug.